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# THE AIMS OF SOCIAL EVOLUTION.*

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Last year Professor R. C. Osburn addressed us on Some Misconceptions of Evolution. While the conception of *organic* evolution is only very gradually being accepted by the population at large, the rate at which it is becoming an established principle among the educated classes, hastens the need for studying the psychological factors that are shaping *social* evolution. It is clear to a group of scientists that social problems are experimental problems. We are no more able, until we have tried it, to affirm that this or that law is a good one, than we are able to predict the outcome of a new chemical combination on the basis of what we know about cooking or gardening.

For those who regard social problems as fundamentally biological in character, what shall be our attitude toward the teleological aspect of all social reform? In natural science this problem never appears. The scientist is not ordinarily concerned with getting a specific result; he is after the facts that may be observed under controlled conditions, and when these are recorded he begins his interpretations quite oblivious of the fact that his guinea pigs do not hold his experiment in high esteem.

When a sociologist or a psychologist is asked to pass judgment on some contemplated social reform, he is expected to estimate its value in terms of *good* or *bad* in addition to predicting its probable influence on existing conditions. When the conscientious investigator seeks a standard of value on which to base his teleology, he finds the literature on this topic overwhelming. He is chagrined to learn that every one seems to know what is good and what is bad, except himself. He may

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rest on some such statement as, a good social reform is one that increases the total *happiness* of all concerned. His curiosity as to the nature of happiness may expire when he learns that happiness is the condition in which internal and external adjustment are in equilibrium.

Before scientific methods can become very effective in social experimentation, it is necessary to establish the direction in which social evolution seems to be going. It is clear that if mankind is to go to the same place where the extinct dodo now is, his social organization ought to be developed along different lines than if he expects to prepare for a career subsequent to his existence on earth. It thus becomes the first problem for the psychologist to determine just what physical and biological science have to contribute toward establishing the probable direction of social evolution. If the search gives promise of a special destiny for man, well and good.

### MAN AS A BIOLOGICAL UNIT.

From the biological standpoint man is a product of organic evolution, and the ten thousand years of his historical period have demonstrated his fitness to survive in the struggle with non-human competitors. This survival is not due to his physical strength. His anatomical structures and physiological processes resemble those of the animals so closely that as scientists we ought to assume uniformity in development rather than introduce cataclysmic conceptions based on non-biological entities of a psychic or vitalistic nature. Accordingly we should consider man and his achievements as the product of the same forces and conditions that were in operation before he appeared.

Man as an organism is an aggregate of sensitive, conductive, contractile, secretory, and supporting tissues, grouped together into the organs, structures, and fluids of the body. Within this body the chemical and physical processes of growth, nutrition, reproduction, occur precisely as in animals and if we consider these vegetative processes only, there seems no justification for assuming otherwise than that the human species will inhabit the earth for a time, to be sooner or later displaced by some other form, as different from man as he is from the nearest animal. When, however, we observe the extent to which man's presence has changed the face of the earth and compare his achievements with those of any existing or prehistoric form, we may well wonder whether some principle of discontinuity was not introduced with his coming.

### ORGANIZATION.

Suppose we consider first whether cosmic development as far as we can picture it, exhibits discontinuity. According to some of the physicists the universe about us is the totality of two entities and their interactions, called *electrons* and *protons*. The electron is defined as a unit charge of negative electricity; the proton as a unit charge of positive electricity; and the properties are those of negative and positive electricity as described in the physics text-books. The dynamic relations between these entities is expressed as the law that like-signed particles repel each other, while unlike-signed particles attract each other.

The chemical elements are to be regarded as different configurations of electrons and protons, the various atoms differing from each other only with respect to the number of electrons and protons that they contain. There is, however, a limit to the size beyond which the electrons and protons no longer hold together as a single *atomic structure*. This limit seems to have been reached by radium which is unstable under any known present conditions, and is continually breaking down into the lighter atoms of lead and helium. However, atomic structure does not represent the limit of cosmic evolution, and the next step in organization consisted in the combination of atoms into a *molecular structure*. Molecules combined to form chemical compounds, minerals, substances. As the culmination of inorganic complexity we find *crystallization* in which a given geometrical form of molecular organization may grow in size by the addition of the free molecules in a supersaturated solution.

The next apparently discontinuous step in cosmic organization was the appearance of the larger *protoplasmic structure;* stable with respect to organization, but unstable with respect to molecular composition. While the protoplasmic element (the cell) is larger and more complex than any organic molecule, it also is limited in its size by a surface-mass ratio which is at an optimum between one-fiftieth of a millimeter for the larger protozoa, to whatever may be the size of the smallest filter-passing bacteria.

The development of a *multicellular structure* was the next discontinuous step in the direction of complexity in the organization of the electron-proton systems. From the smallest

scarcely visible multicellular forms whose weight is given in milligrams, we pass by intermediate steps to the huge prehistoric herbivora whose mass is calculated in thousands of kilograms. Apparently we have here reached the limit of size and complexity in the multicellular type of organization. The large herbivora became extinct and even the larger existing mammals (aside from man's interference) are decreasing in number and are also facing extinction. The reduction in size of the multicellular type has not been equal in all the tissues. In the progenitors of man, the central nervous tissue actually increased in proportion to the other tissues. The direct effect of this increased brain capacity resulted in an increase in the number of interconnections between the sense organs and the muscles. Instead of independent reflex sensory-motor mechanisms, the interconnections which became possible as the brain enlarged, increased the range of the stimuli which could release a given reflex mechanism. The complexity of behavior was then more closely correlated with the *combination of stimuli* than it was with complexity in inheritance. This was the beginning of what we now call learning through experience. The animal's behavior no longer depended solely on specific inherited connections but new environmental conditions were able to produce modifications which individualized the organism and made it possible to develop reactions that were not laid down by inheritance. Science is just beginning to recognize that this greater behavior range is another discontinuous step through which cosmical organization has been extended beyond the simple multicellular type of the large prehistoric herbivora to a *compound multicellular structure* to which we now give the name of *social organization*.

In the relatively unsocialized animals the specialization of the different tissues had already produced a high degree of co-operation between the parts of the body. This interdependence of the various tissues, however, became so complex that the probability of fatal abnormalities became too great. The inadequate function of a single organ, kills the whole organism. With social organization for the group even though the individuals are very highly specialized for certain necessary activities, the death of one individual does not destroy the whole community, as for instance, the death of the heart will destroy the whole body. In other words, the difference between man and the animals lies in man's greater behavior potential-

ities, and this is due to a greater variety in the interconnections between sense organs and muscles. This seems at first to be an insignificant distinction but it made language possible and proved of such great survival value that it placed man so far from the animals that his *relationship* to them is still denied by the population at large and has only been accepted by the scientists during the last seventy-five years.

SUPER-VARIABILITY.

If the essential difference between man and the animals lies in the fact that man's movements are more correlative with the variety of the stimulus combinations which act upon his sense organs, suppose we consider the hypothetical conditions that would produce the maximum variability in human behavior.

Primitive man, as compared with civilized man, is limited in the variety of his behavior by the limited range of his sense organs. At best he can only react to objects within his visual range, a distance of hardly more than a few miles. If an ideal individual existed whose eyes could at any moment, see all the things that have occurred in the past, that are now occurring all over the world, and that will occur in the future, such a superman would exhibit a diversity in his behavior far beyond that of any normal man. With such eyes the superman could discriminate environmental details beyond the range of the normal individual. Such eyes are of course, a physical impossibility but we shall presently see that certain social institutions really make it possible to approach this all-seeing condition. Suppose further that our superman possessed perpetual youth, absolute immunity against disease, the best possible inheritance, unlimited physical strength, and unfailing food and shelter resources. Even if such a superman lived at the same place and time as a normal individual his behavior would differ from that of the normal man. The biological structure of the normal individual is such that many of the environmental stimulating conditions do not produce correlative sensory-motor changes. In our superman the normal biological limitations do not exist and hence his sensory-motor changes would exhibit a higher degree of correlation with the environmental conditions. This is what we mean when we say that the superman is in better equilibrium with his environment than is the normal individual.

Compared with the normal man, our superman may be characterized as omnipresent, omniscient, and omnipotent. In the cosmical sense the superman is an aggregate of electron-proton systems whose changes exhibit the maximum correlation with the changes that are occurring or have occurred in all the other electron-proton systems in the universe. *Homo sapiens* approaches the variability of our superman to a greater extent than does any other animal but even the best endowed individual is far from the ideal. Yet, I expect to show that social organization is one of the devices by which normal man comes nearer to our superman.

We now pass on to consider more in detail some of the limiting conditions which separate the existing man from the superman.

## BIOSOCIAL LIMITS TO VARIABILITY.

The most important conditions which limit the freedom of action of the normal individual may be grouped under five headings: (1) The limitations of disease and death; (2) Limited sensory capacity and restricted environment; (3) Limitations through faulty inheritance; (4) Limitations through essential food and shelter activities; (5) Limitations imposed by the competition between individuals.

To anticipate our conclusions we may provisionally regard human institutions and organizations as agencies by which man actually overcomes some of these limitations, and that social reform or social changes are directed toward developing the one best type of organization that will make it possible to secure the maximum variability for each individual and thus produce indirectly an electron-proton organization which approaches the omnipresence, omniscience, and omnipotence, of our super-organism. We pass on to a consideration of the extent to which social organization has already overcome many of the limitations against the maximum variability in behavior.

(1) *The Limitations of Disease and Death.* Under favorable conditions the span of life lies in the neighborhood of seventy years, the average length between forty and fifty. It is clear that if the individual lives to three hundred years and retains perfect health during this period, the variety and number of his achievements would be greater than they are now, just as under primitive conditions they were less than at present. From the development of medicine since primitive times we see that the

activities of the physician have become very specific. Medical education and the various types of treatment now represent varieties of behavior that are very complex and take up the full time of a considerable percentage of the population. Through the innate variability of the best endowed individuals, medical research has developed sanitary and hygienic methods which have displaced the ritual and magic of the primitive medicine man. The greater complexity in medicine requires every other member of the community to increase his output in order to furnish the food and shelter for the medical profession, but on the whole, the actual leisure of the community is increased, and the probability of still more effective inventions and discoveries becomes greater.

The following are some of the social institutions and co-operative forms of behavior which reduce disease and delay death: Medical education, hospitals, preventive medicine, sanitation, safety first methods, vital statistics, etc. These institutions can only exist under a very complex form of social organization, but even the most advanced medical practice and organization is hardly more than a beginning. Such very effective methods as health control through heredity have not even been tried. It seems reasonable that in so far as medicine is a factor in social evolution it points to an increase in the size and the complexity of social organization, and adds variety to human behavior.

(2) *Limited Sensory Capacity and Restricted Environment.* Anatomically the sense organs of man are of the same general type as those of animals. He sees, hears, smells, tastes, feels, in about the same way, in some cases more accurately, in others less. The animal is limited; qualitatively, by the lack of sense organs for the discrimination of such physical forces as electricity, magnetism, certain forms of radio-activity; spatially, by the fact that a radius of at most a few miles represents the maximum distance at which a stimulus may act; and temporally, in that only the stimuli that occur in the immediate present can be effective in modifying its behavior. Compared with the savage, civilized man has enormously extended the range of his sense organs and his environment by the invention of language. Through language man is able to practically reproduce environments that have occurred in the past or may occur in the future, or which are occurring now but are beyond the limit of direct observation. Thus by the aid of historical language

records, man may at any time reproduce situations that occurred centuries before he was born. Through the newspapers, magazines, books, illustrations, the cinema, he can extend his environment to any part of the earth. Through his radio outfit he is able to hear New York's latest jazz. Through advanced weather reports he is able to adjust himself to temperatures that will not act on his cutaneous receptors for many hours. Contrast this with the limited sensory range and restricted environment of primitive man and we see how the range of modern behavior is extended, not only for the individuals who use the devices but also for those who develop and produce them. These inventions and the social organization through which their products are distributed have the virtual effect of placing the sense organs and the environment of every individual, living or dead, at the disposal of every other individual. We have learned how the past, present and future, the near and the far, can be stored in a library.

The following devices and institutions extend the sensory range and the environment of civilized man and thus produce greater variability in his behavior. Formal historical records, and the many forms in which language manifests itself, cinema, photographs, and other forms of representative art, microscopes and telescopes, radio, power, travel.

It is only by marshalling such an imposing list of social achievements that we get an idea of how the development of the central nervous system has made possible a degree of interaction between organisms entirely beyond the anatomical possibilities. Social organization in the realization of its potentialities will unite all men into one gigantic organization, the individual units of which are only multicellular organisms that exhibit *both* uniformity and variety in their behavior.

(3) *Limitations Through Faulty Inheritance.* Under any given set of environmental conditions all the individuals of a group do not develop the same reactions. Some individuals meet new situations by improving upon established forms of behavior; others cannot even learn to imitate the established reactions. There are thus differences between individuals that are traceable to differences in the type of nervous system that is inherited, and these differences may range from an imbecility which would result in the speedy death of the individual if left to himself, through various stages of dependence and independence, up to the leader who invents and discovers many

new forms of behavior better adapted for survival than those that have been established. Excellence in inheritance thus manifests itself as a quicker learning and an improvement of the standardized reactions. Good inheritance has been recognized as such an important factor in social adjustment, and as occurring so rarely, that most individuals are taught to *imitate* the behavior of the well endowed rather than to rely upon their own innate ability. This results in behavior that is considerably above the average inheritance level of the group. Factory methods make it possible to produce cheaper and better products with workers of poorer inheritance and training than did the older handicrafts. This should release the abler workers for further research, but at present this better inheritance goes to produce profits for private individuals instead of for the community. It is only very seldom that the inheritance and training of the profiteers is directed toward improving the type of social organization.

When the inheritance of the individual is so poor that he does not learn the standardized reactions, as in insanity, feeblemindedness, idiocy, the persistently criminal, the unemployable, he becomes a charge on the community and does not even contribute his share toward the maintenance of the social organization. This further drains off the resources into non-productive channels.

The home, tradition, law, education, division of labor, etc., make it possible to use types of inheritance that would be speedily eliminated under more rigorous primitive conditions but no fundamental scientific attempt has been made to improve the germ plasm of mankind.

(4) *Limitations Through Food and Shelter Activities.* Under frontier conditions practically the whole time and energy of the family are devoted to securing food and shelter and these are of the simplest kind. One of the first steps after social co-operation has begun is to establish some kind of religious or educational activity which introduces variety into the behavior of the younger generation and prepares them for participation in still more variable forms of behavior. Roads and transportation facilities are improved and through the division of labor and the use of machinery the time and energy devoted to food getting are much reduced, and the greater leisure is expressed in a greater variety and better quality of food and shelter. Perhaps in no other field of human activity has social organization pro-

duced such a variety in behavior as in the preparation of dress, food, and shelter.

It is difficult to name a social activity that does not in some way relate to food and shelter, but among the institutions which reduce the time and energy devoted to securing them we may mention: factory methods, transportation, refrigeration, improved agriculture, improved housing, and such indirect methods as insurance, pensions, etc.

From even a hasty consideration of the complexity and variety of institutions such as these it seems evident that biological evolution beyond the huge multicellular forms of the primitive herbivora has taken the form of an increased complexity in behavior, and this in turn is secured through an increase in the relative amount of nervous tissue. If we are correct in assuming that cosmical evolution, in so far as this term has any significance, is in the direction of the formation of larger and more complex aggregates of organized electron-proton systems, the activities of the highly individualized multicellular form known as man, exhibits this tendency in his food and shelter organization in an almost irrefutable clearness.

(5) *Limitations Imposed by Competition.* While competition introduces variety into the behavior and develops inventiveness for a few of the abler members of the group, too large a proportion of it is directed toward decreasing rather than increasing the community's resources. Under primitive conditions where social organization is limited to rather small groups, competition in the shape of war may take up all the time and energy of a considerable part of the group. Even under modern peace conditions there is a constant lack of balance between the workers and the amount of work to be done which results in an actual reduction in the variety of behavior.

Social organization has made least progress in the elimination of useless competitive behavior. The most effective instrument, that of scientific research, has scarcely been introduced. Such institutions as civil service, vocational or specialized training, labor unions, employers' organizations, producer's organizations, trusts, treaties, and agreements, have eliminated or regulated competition, between particular groups of individuals; but this is usually nothing more than a transference to a less organized group. Thus the coal operators may combine to limit competition among themselves, the miners may organize for higher wages, but there is no decrease in the cost of coal to

the unorganized consumer. However, ineffective modern business methods may be from the scientific standpoint or as compared with engineering, they are the first steps toward a more equitable distribution of commodities which in turn will result in greater variety in behavior.

### LIMITED VARIABILITY.

We have seen how social organization is a device for overcoming the restrictions which limit the variability of human behavior, particularly as referring to disease and death, sensory capacity and restricted environment, faulty inheritance, essential food and shelter activities, and competition. We profess to see in this a cosmical evolution of electron-proton aggregates into a greater and more complex organization. The evolution is not smooth and uninterrupted. At times the processes of disorganization seem to have the upper hand. Thus it is urged that as economic pressure is removed the variability of man's behavior becomes less rather than more; that if man is required to work less he will loaf more. This is undoubtedly true for a large proportion of the population at present. For most individuals greater leisure is merely an opportunity to "catch up sleep" or to secure the required rest for adequate metabolism. Aside from the inactivity that greater leisure induces under unfavorable nutritive and shelter conditions, the daily tasks are not the ones most individuals would perform if they were independent of their social environment. The behavior which would occur if only inheritance and an irresponsible immersion in a social environment were operative (the so-called instinctive behavior) does not fit the individual for any given social status. In other words, civilization is largely a process of substituting standardized reactions for those that have been inherited. This is a slow process mediated by other individuals (parents, teachers, instructors) not all equally effective in manipulating the environmental conditions for producing the change. Thus, even with similar original endowment, limited variability may result from differences in training.

Another source of limited variability in behavior results from the fact that social organization has produced a standardized behavior which reflects a better inheritance than most individuals actually possess. In other words, the daily activities of the greater part of the population are actually above their inheritance level. If now, the average individual secures

more leisure he will not devote this to art, literature, science, which are on an even higher inheritance level than his vocational activities, but he will *relax* to recreation that is nearer his own inheritance level, the movies, cards, foot-ball, base-ball, hunting, fishing, etc. Unless the individual is educated how to spend his leisure he can only spend it on the level of his own innate capacities, and for the average individual this is not much above that of a normal twelve-year-old child. To expect a laborer to spend his spare time in "improving his mind" is biologically unwarranted until we introduce a eugenic and educational program so different from anything we now have that it need not be considered. Under present conditions there will always be a relapse into more primitive and more instinctive forms of behavior whenever social pressure is removed. Any reform in the direction of better working conditions and shorter hours for the masses which assumes that the added leisure will be devoted to intellectual pursuits, is doomed to failure.

Social organization and the processes of civilization are devices by which man approaches omniscience, omnipotence, and omnipresence, but we can now realize that there is no danger of breaking any speed laws. The unification and the individualization of behavior which represent the biological essentials of this aim, are well started but our social organization is still very far from adequate to enable each individual to develop the maximum variability which could be expected from his inheritance and an ideal educational system.

## THE INDIVIDUAL-SOCIAL COMPONENTS IN BEHAVIOR.

As the individual learns to adjust himself to his environmental conditions, his behavior varies in two directions. It may become more like that of other individuals and contribute to the necessary activities of the community, or it may become more individualistic and conform more closely to his inherited sensory-motor conditions. Practically all adult reactions have been highly socialized, yet even in the most standardized reactions a personal or inherited peculiarity can always be pointed out. Every adult reaction began as some infantile reaction in which the inborn or individual component alone was operative. Through the subsequent stimulating conditions, the infantile reaction is changed; either by the addition to it of other movements, by the elimination of some movements, or by the elimination of some and the addition of other (substitution)

movements. Every act that we now perform represents a terminal stage in a regressing series of changes which began with some original or first response. Each step in the series represents a change (small or large) from the preceding step. Theoretically it should be possible to trace back every adult act to some infantile source but the changes are so rapid and the relations between successive steps are so obscure that the analysis into the inherited or acquired components is practically impossible. The cause of each change is usually a social stimulus of some sort, a teacher, book, friend, etc. The further back the series reaches the stronger the individual component manifests itself. The nearer the series approaches the present, the stronger the social component becomes and the more effectively does the behavior establish the social status of the individual. The behavior of every person who actively participates in the workaday activities of the community is being constantly brought into closer unity with a communal or special group average, but the process of socializing is always superimposed upon the individual component, which acts as a desocializing force and tends to individualize behavior.

A concrete illustration will relieve the abstract character of the discussion. Suppose a hundred seniors are asked to write a theme on civics, of a specified length, and within a limited time. Assume that they are free to write on any phase of the subject and that every student does his best. When the papers are examined it is found that not all the papers cover the same phases of the topic. The historical, political, theoretical, ethical, international, industrial, economic phases will be emphasized in very unequal degrees, and will be treated with very unequal degrees of merit. This variety or individualization of the papers even though the instructions for each student were the same, represents the individual component. The fact that the topic of the theme, its length and the interval within which the paper was completed, was practically the same for all students, represents the social or the unifying component in the behavior.

Beginning with the movements of a new born infant which are to be regarded as reflex sensory-motor mechansims either inherited or of embryological origin, there is a gradual increase in the number and complexity of those movements that make up behavior through youth, maturity and old age. The *reaction* to the environment at any given instant may be regarded as one stage in a *series* of reactions which trace backward to

infantile reactions and forward to a terminal stage in the daily life of the individual. The *behavior* at any given instant may be regarded as a *unified* group of reaction segments from different reaction series. The character of each series shows the effect of the environment and inheritance, classified into an *individual* and a *social* component, as follows:

*A. The Individual Component.*

1. The type of nervous system that is inherited. (pugnacious.)

2. The stimulating conditions that represent the primitive and relatively unsocialized environment. (The out-of-doors.)

3. The effect of inheritance or special training in the synthesis of new reactions.

4. The earlier stage (as compared with the later) of a reaction which is being modified.

5. The type of behavior popularly designated as: an end in itself, recreation, play, personality, originality.

6. The social conditions which differentiate and individualize behavior.

*B. The Social Component.*

1. The type of nervous system that is acquired. (Obedient.)

2. The stimulating conditions that represent the most recent and most socialized environment. (School or office.)

3. The effect of conventionalized training in the formation of new reactions.

4. The later stage (as compared with the earlier) of a reaction which is being modified.

5. The type of behavior popularly designated as: a means to an end, routine, work, impersonal, and unoriginal.

6. The social conditions which standardize and conventionalize behavior.

THE INDIVIDUAL-SOCIAL COMPROMISE IN BEHAVIOR.

The life history of the individual represents a series of compromises between the actions which he actually performs and the ones he would perform if left to himself. The question arises, why does the individual modify his behavior to conform with the unity demanded by society? The answer is that many individuals (the socially abnormal) *do not.* But under ordinary conditions the *social* environment into which the individual is born, soon becomes the strongest stimulus. This means that our social organization from the very beginning presents stimulating conditions (education) that unify behavior rather than individualize it. The *innate* tendencies are in the direction of individualization and usually opposed to socialization. There is so to speak, a constant fluctuation between old and new forms of behavior. Often it is impossible to enumerate the conditions which cause either the new or the old forms of behavior to appear, and to the individual there seems to be a conflict which he is able to decide through some sort of a mental act that is independent of the stimulating or nervous conditions which are operative at the time. This is an illusion and merely an

expression of the fact that the individual is unable to designate what biological causes were effective in the action that actually prevailed.

As a problem in social organization we may agree that the more the individual component can be made to contribute to socialized behavior, the nearer do we approach the maxim effectiveness of the individual as a member of a given social organization. In order to participate, the individual must act on a schedule and fit his behavior into a system which may deviate widely from his individual schedule or system. The ideal conditions would be those in which the unmodified individual behavior plan would fit into some phase of the social plan. Such an ideal synchronism between the individual and social components occurs very rarely, but for each individual there is a social plan which fits his innate capacities better than any other. Thus to make a professional musician out of a child whose innate musical ability is low, will require more supervision and training per unit of improvement than in the case of a child who has inherited musical talent and for whom work in music would be individual behavior. If further, the musical individual is able to use his talent to meet his vocational requirements, as in teaching music, musical composition, conducting an orchestra, etc., his socialized activities will be almost identical with his innate capacities. This will give the most favorable conditions for developing the *art* of music. Speaking generally this means that the individual's innate endowments may contribute socially necessary activity. His work then becomes his hobby; work becomes play; the right man is in the right place; etc.

The individual-social compromise in behavior is merely a statement for the fact that every adjustment that an individual makes to a new environment is a compromise between an older established reaction to the nearest similar environment, and the new stimulating conditions that produce a change in the established reaction.

## HAPPINESS.

In the more democratic forms of government any reform which would entail a permanent reduction in the total so-called happiness would be regarded as a failure. This will generally be accepted as a fundamental principle, but when we actually examine what the phrase means, we find it so vague that it will

support any argument. The writers on ethics are agreed that any attempt to designate the concrete circumstances under which a given individual will be permanently happy is hopeless. It is not my intention to consider happiness from the ethical standpoint, but as a *relationship* between the amount of individual behavior, and the amount of socialized behavior.

From the cosmical standpoint we found that the superiority of man over the animals was due to the greater variability of man's behavior. Therefore any condition, which, in the long run, favors variability in behavior has a survival value, and any condition which limits variability, has no survival value. In other words, "the active man will inherit the earth and the lazy man will perish." Can we say that the greater the activity, the greater the happiness? If activity is taken in the strictly muscular sense, as the amount of chemical energy converted into heat and work, then activity and happiness have nothing to do with each other. Evidently the *kind* of activity is important. It is usually recognized that greater activity is shown when the individual component (play) predominates than when the social component (work) predominates. Without taking the quantitative aspect too critically we may regard the individual component as the numerator and the social component as the denominator of a ratio which roughly measures what we may call biological happiness. The greater the ratio the greater the happiness. Neurologically, happiness means that the nervous system of the individual is being exposed to those environmental conditions which support the maximum individualization of behavior. Happiness in this sense is not a vague psychical feeling or a mysterious entity within the individual. It is merely an indication that the activities of the individual are conforming to those biophysical and cosmical principles which will in the long run produce larger and more complex electron-proton aggregates and larger and more complex social organizations.

Much of the popular theory on social organization assumes that an increase in happiness also entails an increase in misery at some other point, and the extreme view that happiness is in some way an evil, still has adherents. The more highly organized a community may be, the greater are the possibilities for using the innate capacities of the individuals for increasing the effectiveness of the standardized or required activities. It is possible therefore, to reduce the essential drudgery in life to a minimum. Through such devices as job analysis, individual

analysis, and by fitting the two together, the individual-social ratio (standard of living) of the population can be raised enormously.

Through the aid of written language the range of the sense organs is much increased; industry, machinery, power, sanitation, have removed other limitations against the freedom of behavior. However, the very conditions by which some limitations are overcome also introduce new standardized forms of behavior. In fact, under our present highly civilized and specialized system, the life of an unskilled laborer may actually be less individual than that of a savage. The boredom of the idle on the other hand, is often merely the social condition in which the training of the individual has not gone far enough to prepare him for the type of variety available under the social conditions. By clearly recognizing that civilization is merely a device for extending the range of human variability in behavior, the conception of human happiness can be given a biosocial significance which is relatively independent of the fluctuating ethical and moral standards which vary so much from country to country and from decade to decade. The aim of civilization then becomes one of co-operation for creating opportunities so that every individual while on earth may establish an optimum relation between his individual and social components in behavior. Such a conception reveals clearly that happiness can only be a reciprocal process. The behavior must conform with our inherited and acquired capacities and in the long run must be in the direction of increasing the total variety of behavior through the development of larger and more complex forms of social organization.

In so far as social science has developed a working hypothesis, this is based on the old assumption that man is the center of the universe and that everything revolves around him. It is assumed that man knows what he wants and the only reason he does not get it is because he is so selfish that he wants more than the available resources of the earth can supply. That happiness is not a matter of wealth, we know, even though most of us are willing to take a chance on handling a larger amount of it than we actually possess. As a matter of fact we do not know what conditions are most favorable for happiness. This is just as much an experimental problem as any medical problem. The greatest development which can take place in social theory would be the recognition that human behavior is not the

result of hate, love, fear, anger. These are but names that came into use before we knew the biological basis of behavior. When a man has an epileptic seizure we no longer say he is possessed of the devil; why should we ascribe the act of murder to the devil of revenge? It is high time that the brain and nervous system are regarded as biological structures rather than supernatural agencies in radio communication with a celestial spirit reservoir. It is the brain and nervous system that is the organ of behavior and the brain is no more the organ of an abstract intellect than the heart is the organ of love. Whatever we may include under the term happiness, it is a problem for science, not for poets, politicians, or mystics.

### THE HISTORICAL BEHAVIOR RECORD.

A much larger percentage of the population is beginning to see that human behavior need not be regarded as the product of unknown forces originating out of magical and superstitious principles. The improvement and the more widespread teaching of science and of history reveal a uniformitarianism between successive historical periods which is of the same order as that of the geological or biological record. The educated man is slowly beginning to class human behavior with human digestion, respiration and circulation. From a statistical analysis of the behavior of historical persons and groups, hypothetical life histories and behavior types are being developed and incorporated into our educational system as biological factors in the modification of conduct. From the historical record, man's destiny seems to be a biosocial destiny. What he does depends on the type of nervous system he has inherited and the social environment into which he was born. Today's behavior is the result of yesterday's actions and the cause of tomorrow's behavior. Individuals are forming groups, groups are forming federations, states, nations, alliances, and an attempt has even been made to form a league of nations. The final stage in which all peoples on earth will be united through some organization may be a long way off, but it is biologically inevitable. War cannot prevail because it can only use scientific methods destructively and soon becomes self-limiting because of the expense. At present it is a race between science in social organization and science in war, in which scientific social organization will eventually prevail.

SUMMARY.

Cosmical evolution is a relatively discontinuous process in the direction of an increase in size and an increase in complexity of the ultimate electron-proton elements out of which the universe is constructed.

The *inorganic* organization of electrons and protons produced the atom, the molecule, the crystal; the *organic* organization of the molecule reached one limit in the protoplasmic cell and a second limit in the large multicellular herbivora. *Social* organization begins with the development of the multicellular organization such as the bees, ants, wasps, and terminates in man. The relatively greater amount of nervous tissue in man's progenitors resulted in a greater variety in their behavior. A greater variety in behavior made possible an adjustment to environmental conditions for which no specific provision had been made by inheritance. This has been called learning by experience. The social organization of man is a double process: one phase directed toward an individualization of behavior; the other toward a standardization of behavior. The aim of social evolution as a cosmical process is that of producing larger and more complex electron-proton aggregates, but as a human process, the aim of social evolution is that of developing a social organization that will yield for each individual a maximum of individualization with a minimum of standardization. The ultimate realization of these conditions will produce a social organization and a type of individual that have as upper limits those conditions best described as omnipresence, omniscience, and omnipotence.

To rephrase this less technically and stressing popular conceptions of little scientific utility, we may say that man's morality, his culture, his aims, and his aspirations, are limited by certain biological restrictions. Within these restrictions his behavior may vary between wide limits. The best morality, the best culture, can only be determined by scientific methods. They cannot be determined by the methods of poetry, magic, of superstition. When the best morality, the best culture, have been determined, their achievement will again depend upon a scientifically developed social organization.

When we contemplate what science has done for us let us realize that so far we have only been called upon to *accept*. Will we *give* to science with as good grace?

Physical science has given us better shelter, better transportation, better communication, better of all that which is material and has asked naught of that which is based upon our emotional heritage.

Biological science has given us better food, better bodies, better of all that through which man's conduct may express itself, but in its demand upon our faith and belief in the theory of organic evolution it is asking for what to us, at one time *seemed* a spiritual sacrifice, and *is still*, a spiritual sacrifice for unschooled mankind.

Social science has given us better protection, better organization, better training, better of all that through which man approaches a destiny which we only fearfully and with awe contemplate as omnipresent, omniscient, and omnipotent, but its demand upon our courage to sacrifice long cherished beliefs and ideals, to a cold but inexorable scientific method which brands many of them as illusions and errors, is now all but impossible for the elect in knowledge and unthinkable for humanity in the large. Will we learn to give of our great faith in tradition, as freely as we have accepted our greater creature comforts?

# EMERSON McMILLIN*

BY

Dr. T. C. Mendenhall

For more than a quarter of a century the name of Emerson McMillin has been a familiar one to members of the Ohio Academy of Science. Annually throughout that period, with unbroken regularity, a check bearing his signature has been received by the Academy, the proceeds of which were devoted to the encouragement of scientific research, through small grants of money, generally, though not necessarily, restricted to its own membership.

Personally he was known to a very few members of the Academy, but in the busy world of finance, material development and courageous enterprise he was known as a great leader.

Public utility engineers placed him in the very front rank of their profession. He was chosen to membership in many of the leading scientific and technical societies and for several years he served as the president of the New York Academy of Sciences.

Artists and musicians found in him a generous though keenly critical patron and in the discussion and study of world problems his reputation was international.

These things and many more are put down to the credit of one who ended the period of his formal education at the age of ten years, beginning his struggle with the world as a common laborer in a charcoal-burning iron furnace, at a daily wage of twenty-five cents. The story of the succeeding three score and ten years is like a fairy tale, though it is the story of a life in which fairies played no part. Few men who have risen to distinction owe less to fortuitous circumstances than Mr. McMillin and few have been so entirely "self made," in the best sense of that hackneyed phrase.

Aside from the indebtedness of the Academy to him for continued financial assistance, a body mainly composed of those professionally employed in the training of young people

* Read at the meeting of the Ohio Academy of Science at Oberlin, on March 31, 1923.

may well pause to consider a career so full of inspiring example and high ideals.

As one might infer from his name, Mr. McMillin was of Scotch ancestry, his great grandfather having emigrated to America early in the eighteenth century. His grandfather, Edward McMillin, born in Virginia in 1765, lived to be eighty-nine years old, and his father, William Reid McMillin, was born in 1803 and died in 1881. In view of his great interest in astronomy it is perhaps worth while to record the fact that I have been able to fix definitely the age of his grandfather through Mr. McMillin's recollection that on the day of his burial the sun was almost totally eclipsed, the date thus ascertained being May 16th, 1854.

All of his ancestors were people of long life and sturdy physique and from them Mr. McMillin inherited unusual physical strength and rugged health.

One of the younger members of a family of fourteen children, he was born in the small village of Ewington in Gallia County, Ohio, on the sixteenth of April, 1844. He died, after a short illness, on May twenty-first, 1922, at Darlington, his country seat in New Jersey.

During the first ten of these seventy-eight years his life was little different from that of thousands of the sons and grandsons of the hardy pioneers who emigrated from the colonies of the Atlantic coast to the Ohio valley.

There was the usual one room school in which the curriculum was limited to the "three Rs," though Mr. McMillin remembered that during one term one pupil studied English grammar, and during two terms geography was taught to one class.

It is not unlikely that his leaving school at the age of ten years was due, not so much to a necessity for self-support as to the fact that, considering the grasp of his mind and the rapidity with which he acquired information, he had at that early age absorbed and assimilated all that the small country school had to offer him.

But his love of study and thirst for knowledge did not end with his farewell to the twenty foot square school room, although it was his last and only opportunity for systematic instruction.

It is important to note, also, that work—hard, physical work—was to him a joy and he found in every task something upon which his active mind might feed.

Employed as a common laborer around an iron furnace in what is known as the Hanging Rock iron region, in two years he had mastered the mysteries of the engines, boilers and all other machinery used in such a plant, and at the age of twelve was regularly enrolled as Assistant Engineer of the furnace, having full charge of all machinery from twelve at noon to midnight, receiving a wage of fifteen dollars a month, with board and lodging, the latter being in the engine house itself.

At fourteen, being a lad of unusual physical strength, he discovered that he could improve his condition financially by becoming a wood cutter and charcoal burner, an occupation which held him until he was seventeen years of age.

In the meantime, in spite of the fact that twelve hours out of each twenty-four were spent in hard labor, he found other hours for reading and study. In this he profited greatly through the possession of a remarkable memory. For example, besides being able to spell correctly every work in McGuffy's spelling book, he could tell whether the word was in the upper or lower half of the page, and in which of three columns it would be found.

In a letter received a few years ago he told me of his first interest in the science of chemistry, which was developed during his charcoal period, though at that time he had neither seen nor heard the word "chemistry."

That he was getting something of a hold upon the science, as yet nameless to him, is proved by the fact that being allowed to construct a charcoal "pit" or furnace according to his own plans, he got from it an increase of twenty-five per cent in quantity, as compared with the usual form, while the quality was so much improved that his charcoal carried off all the prizes offered by the furnace company.

At the age of seventeen years he responded to Lincoln's first call for volunteers, enlisting as a private soldier in the Civil War, from which he returned more than four years later, a commissioned officer, with five wounds testifying to his courage in action. He was one of six McMillin brothers, all of whom entered the army, three only returning alive.

From 1861 to 1865 were four memorable years in the life of Emerson McMillin. In addition to the ordinary accoutrements of a soldier his knapsack always held three books. One of these was a textbook on astronomy; another on geology; and a third on chemistry. The astronomy enabled him to study the

heavens intelligently while standing guard at night; the mountains of West Virginia, where most of his campaigning took place, afforded excellent opportunity for illuminating the text on geology; with practical chemistry not much could be done, but that came later.

Soon after the close of the war Mr. McMillin found congenial employment in a small gas works of which he shortly became manager. This offered an opportunity for the study of chemistry in a laboratory, which he immediately created and in which he could often be found at work until two o'clock in the morning. It was also his introduction to a field of industrial activity in which he soon reached the first rank, for along with the scientific knowledge and technical skill which he acquired with wonderful rapidity, he developed a keen understanding of financial problems, especially those involving projects in industrial engineering.

He became, indeed, an engineer in the broadest and best sense of that word. His preparation for the many sided activities in which he was gradually absorbed demanded a degree of enthusiasm, industry, courage and capacity for work extraordinary, even for that period, though not so rare then as now. The generally recognized absence of these qualities in many of the present generation of young men is often explained and excused by the statement that it is a necessary aftermath of war and that the same condition existed for several years after the close of the Civil War. One who had much to do with young people during that period ventures to record a strong denial of that assertion.

To the great majority of those who served through those four years the Civil War was an invigorating and toning experience. The Emerson McMillin, aged twenty-one at the end of the war, was, in many respects, far more than four years in advance of the boy who entered the army at seventeen.

He had learned to hold himself under the most rigid discipline. A good many years later, when he was at the culmination of his career as a Captain of Industry and a successful financier, I was his guest for a few days at his home in the city of New York. Although he had then passed the meridian of life, as it is usually fixed in years, his capacity for work and for the rapid absorption and assimilation of information was undiminished. In the evening he would engage his guest in a discussion of some of the latest advances in physical science,

which might last two or three hours; then two or three more hours would be passed, most delightfully, in his large and rapidly growing gallery of paintings. By this time the small hours of the night would be at hand and the guest, who just then was throwing off all duties and responsibilities and running away from work as fast as he could, was quite ready for an "intermission" knowing that Mr. McMillin would still have a few hours at his desk before ending his day.

During fifty years of his life five and a half hours only, out of every twenty-four, were allotted to sleep and almost invariably he was in his office on Wall Street before any of his clerks, often anticipating the arrival of the janitor.

Though always reluctant to speak or write of himself or his work, in response to my earnest request for some details regarding his early life, he sent me about three years ago, a most interesting letter, from which I quote the following concerning his personal habits and tastes:

> "For twenty-five years I devoted five hours per day to the study of some branch of the sciences that was useful to me. Later, when my work became largely financial I devoted that five hours per day to other studies, but systematically, Art (painting, chiefly), History of Music, French, Social and Political History, etc.; never less than one year, and in one instance, five years to one study. My sleeping hours were five and a half out of twenty-four, for fifty years."

Mr. McMillin's management of the small gas works soon attracted attention. My own first knowledge of and contact with him came about this time, when Dr. Edward Orton, then president of the Ohio State University, whose appraisement of young men was almost unerring, remarked to me, "There is a young man down at Ironton of whom we shall hear great things one of these days; his name is Emerson McMillin."

Though self taught (with the aid of a text-book) Dr. Orton had found him well informed regarding the geology of the region and sound in his geological reasoning.

He had mastered Civil Engineering sufficiently to enable him to locate and survey a line for a railway in Southern Ohio, and his report included an excellent discussion of the mineral resources of the territory to be served.

His activities in this direction very naturally created in him an interest in the manufacture of steel and iron and for several years he was engaged somewhat extensively in that industry in addition to that of the production of artificial gas,

which was, after all, first in his mind, and to which before long he gave himself exclusively.

Just forty years ago, in the year 1883, opportunity came to him in the form of a call to the city of Columbus as manager of the gas works. In the meantime his intensive study of chemistry, physics and other branches of science relating to the manufacture of gas had been fruitful in the invention of a method of purification which materially affected both quantity and quality of the product. For many years the people of Columbus had been paying an exorbitant price for an inferior quality of illuminating gas and at last relief was sought in a change in the management of the works.

Mr. McMillin was chosen as manager at the then unusually high salary of four thousand dollars a year. In a comparatively short time the president of the Gas Company declared that the salary of the manager was being paid out of the economies which he had introduced which, together with a greatly reduced cost of production due to the use of scientific methods, made it also possible to reduce the price to consumers.

He devoted five or six years to the development of the Columbus plant, all being done in harmony with one definite plan which may be said to furnish the key to his great success; namely, to supply the best possible product at the lowest possible cost to the consumer, on the principle that the interests of the producer and the consumer were one. In a few years he was not only the manager but also practically the owner of the Columbus gas works and there came visions of larger operations in engineering finance.

His next step was perhaps the most important in all his career, for because of its magnitude and success he became at once a national figure in the field of industrial management.

The city of St. Louis had been cursed for some years by the existence of four competing and continually warring gas companies, both consumers and stockholders being the victims of unscientific and irrational methods of doing business. In this situation Mr. McMillin saw an opportunity for bringing about a consolidation of interests which would greatly benefit all parties legitimately concerned. His success at Columbus was a sufficient guarantee to win for him the support of some bankers in New York City and after overcoming many difficulties, the four organizations were amalgamated into the Laclede Gas Company.

Of the many phases of this operation, there was one of sufficient interest to justify special mention at this time and in this place. The successful achievement of the result depended on certain agreements with the city government regarding franchise. It must be regretfully admitted that forty years ago the code of morals in legislative bodies, especially in municipalities, was of a distinctly lower plane than even at the present time. Among a certain class of office holders, receiving pay for votes in awarding contracts or granting franchises, was regarded as a perfectly natural proceeding and a practice the existence of which was generally known. Heavy demands of this nature were made upon Mr. McMillin, and one small group, believed to be sufficiently powerful to determine the result, notified him that nothing less than twenty-five thousand dollars would secure the legislation necessary to accomplish the end he had in view.

Not long after this ultimatum had been issued I happened to be in St. Louis for a day and accidentally met Mr. McMillin. The question had been settled, the victory was his and sitting together at luncheon he gave a most vivid and entertaining account of his battle with the spoilsmen.

"I have millions," he told them, "for development and improvement, but not one dollar or one cent for tribute." He made them understand that he would sacrifice all that had already gone into the enterprise rather than yield an inch. The yielding came from the other side and was complete, though probably accompanied by great astonishment at Mr. McMillin's attitude which was doubtless a novel one to the city officials. Evidently they concluded that a man who would not buy could not be bought and from that time the mutual relations of the municipality and the new company were established upon that basis.

The success of this, his first very large venture in the field of public utility reorganization was so great that he immediately gained the confidence of conservative and influential financiers and capital, practically unlimited in amount, was available for similar enterprises, a number of which he undertook and successfully completed.

Unquestionably his success was largely, and in the beginning mostly due to the "five hours every day" devoted, during a period of twenty-five years to the intensive study of the "sciences that were useful" to him. During these years he had

not only acquired knowledge, but his naturally keen intellectual faculties had been brought to a high state of discipline, ready to attack with vigor and usually with success, any new problem which might present itself.

Up to the year 1891 he had been generally serving others, organizing and executing projects of which, though inspired by him, he did not have complete control. In that year, however, he resigned from a very lucrative position to enter the business and financial world on his own account. Associated with him in this venture was Col. Henry B. Wilson of Ironton, (brother of the late Col. E. S. Wilson, editor of the "Ohio State Journal") with whom he established in Wall Street, New York City, the banking house of Emerson McMillin and Company.

This took him more completely into the field of finance and the promotion of public utilities, thus practically terminating the period during which he personally managed the enterprises which he controlled. But it cannot be without interest to the group of men for whom, primarily, this sketch has been prepared, to note that behind McMillin, the financier, was always McMillin, the engineer. The success of the firm of Emerson McMillin and Company was immediate and great, for in all of its undertakings it was guided by the engineer's instinct and the engineer's caution.

To the purchase and reorganization of gas producing plants there was soon added the acquisition of electric light and traction properties. The operations of the firm were co-extensive with the United States and at one time it controlled more than forty such corporations, including those of many of the principal cities. In 1901 these were combined into one giant corporation, the American Light and Traction Company, with a capital of over forty millions of dollars and Emerson McMillin as president.

Later in life he gradually disposed of a majority of these properties but at the time of his death he controlled seventeen of them, including a number of the largest and most important, and he continued to the end, to take an active and keen interest in the affairs of his house, presiding at a meeting of the executive committee only a few days before his death.

It would be interesting and instructive to consider in some detail a few of the more extensive operations in which he was engaged, but I confine myself to one or two of the most difficult and most important, illustrating those qualities which insured the success of his undertakings.

It was he who organized the company for the construction of the tunnel under the East River, connecting Long Island and New York City. At the beginning of this great enterprise and up to the day of the formal opening of the tunnel many able engineers pronounced it an impossible achievement. Great difficulties were encountered during the construction period; stockholders were discouraged and disheartened but the work was guided by one who had not known failure and whose efforts were again rewarded with success.

Mr. McMillin was one of the first to appreciate the tremendous potential value of the Welsbach non-combustible mantle for incandescent gas-lighting and he had a large financial as well as a scientific interest in its development and practical use in this country.

Because this process greatly reduced the quantity of gas consumed per candle power of illumination many gas producers were actively opposed to it, but McMillin had achieved distinction as a gas engineer upon the sound economic policy that by diminishing the cost and at the same time improving the quality of a commodity in general use a greatly increased demand for it would be created. Better light and cheaper light would mean more light and in spite of long and discouraging delays in the perfection of the process the soundness of his judgment was established on the pages of his ledger.

But in the meantime, along with the rapid development of his business enterprises there was an equally rapid and even more notable development, growth and evolution in the man himself. As Col. E. S. Wilson once said of him, "McMillin grew faster than his wealth."

The five hours of intensive study each day, devoted, during many years to the various branches of science which were contributory to the solution of engineering problems incident to his extensive undertakings, were subsequently spent upon Art, Music, History, Political and Social Science, Foreign Languages, etc., "always systematically," and their cultural effects were strikingly noticeable. There was nothing superficial about his knowledge and accomplishments, and it is, therefore, not so strange that the youthful charcoal burner, who studied the heavens while standing guard at a military post in time of war, became a devoted student of art and a collector with a discriminating sense of values rarely excelled.

It is common to divide "money-getters" into two classes: those who desire wealth as a means, and those who seek it for its own sake. I think Mr. McMillin belonged to neither of these groups. His pleasure, his real joy, was in doing the job, in beating down the obstacles that rose in his path, and on such men Fortune rarely fails to smile.

To one to whom wealth comes in this way the problem of making good use of it generally receives serious consideration and it often proves to be a most difficult one. Mr. McMillin's gifts of money for the relief of the unfortunate, for civic or educational projects, were numerous and large and in a great many instances individuals who profited by his generosity never knew the source of the help which came to them. In addition to giving money he gave much valuable time, being never too busy to give careful consideration to the claims of any cause which promised to be fruitful.

At an early period of his residence in New York city he came to be recognized not only as a master of finance but as a man whose interests were broad and liberal and he was soon a member of numerous organizations of a public character having for their object the public good.

He was greatly interested in World Problems, being a member of the "Committee of One Hundred" which had for its object the establishment of a "True International Court of Justice" and he was one of the principal organizers of the "World Court League." Shortly before his death he accepted the presidency of the Arbitration Society of America.

Throughout his whole life Mr. McMillin gave freely of his resources to the aid of suffering humanity, though because of his modesty and reluctance to speak of his own work, the full extent of his generosity will never be known. During a period of at least forty years he employed agents to investigate and report upon cases which appealed to him and his distribution of charity was made with the same careful discrimination that had guided him in business.

In our war with Spain, Mr. McMillin, past the age of actual military service, was represented by his son, Marion, who bore the name of one of the three McMillin brothers who gave their lives in the Civil War. He also gave generously of his wealth, especially in making provision for the wives and children of soldiers, purchasing a farm in West Chester County, New York, and founding a home for that purpose.

After the close of the war he converted this plant into a "Vacation Home for Factory Girls" which he maintained for many years entirely at his own expense.

At the beginning of the recent great war and before the United States had entered it, Mr. McMillin was a large contributor to the financial support of Italy, for which country he had formed an attachment during a visit of some length a dozen years earlier. This friendly interest received a graceful and generous recognition on the part of King Victor Emanuel. It is unnecessary to say that when his own country became one of the participants in the great conflict he was an earnest and efficeint supporter of the government in all of its efforts to insure victory.

In actual military service the family was again represented by Captain Marion McMillin who served throughout the war.

Mr. McMillin was a member of many clubs and societies, forty or fifty in all, though he would hardly be called a "clubbable" man. Though fond of his friends and generous in hospitality there was not much room in his life for frivolous conversation or unimportant commonplace.

For his recreation he sought the open; he had an intense love for the forest, possibly a heritage of his boyhood, and he was a hunter of both big and little game.

His lifetime interest in astronomy led him to erect and equip an astronomical observatory for the Ohio State University, known as the Emerson McMillin Observatory, which, in the hands of its able Director, Professor Henry C. Lord, has been the means of making numerous important contributions to the science of astronomy. To this generous gift he added the endowment of a Fellowship in Astronomy, for a period of five years, and he made further gifts of money from time to time, for the purpose of enabling the Director of the Observatory to attend important conventions, also financing completely an astronomical expedition to the Hawaiian Islands, for the purpose of observing the effect, if any, upon the solar spectrum, of the transit of Halley's comet across the disk of the sun in 1910.

The University is indebted to him for other important gifts, including several thousand dollars for the purchase of books for the Law Library and also a sum of money which made possible the acquisition by the Geological Museum of the only complete skeleton of the Megalonyx in existence.

Mr. McMillin was one of the first to show an active interest in the development of aeronautics, contributing in money nearly forty thousand dollars for the investigation of aviation problems, and he also offered to pay the cost of training two hundred pilots.

Much other evidence might be given of his readiness to contribute to "the increase and diffusion of knowledge among men," as well as innumerable instances of his generous aid to the distressed and unfortunate. Never forgetting the limitations of his own boyhood he had more than a mere responsive interest in the ambitions of young people to secure the benefits of an education and, in a large and systematic way he undertook to assist them, though the source of the aid thus rendered was seldom known by the beneficiaries.

Out of a considerable number of experiments in this field of philanthropic endeavor it is not strange that there were some failures. Among those who were directly helped by gifts of money, results were so unsatisfactory as to produce a definite and decided opinion that to attempt to create a career for a young person by an outright gift of money was illogical and doomed to failure.

This lesson was undoubtedly a bitter one but as Mr. McMillin's experience is worthy of the careful consideration of all who are concerned with the education of young people I think I am justified in giving a brief resumé of it, as it came to me in his own words a few years ago:

"During a period of about ten years, beginning with the year 1900, I helped twenty-five persons to obtain the kind of an education they most desired. They were practically supported by me for one, two, or three years; were mostly girls and the greatest number of them were educated for teachers; many for music. . . During this time there were about twenty-five boys with our companies who evinced an interest in the sciences. They were given opportunities to develop, to use the scientific libraries and laboratories.

"RESULT: All those helped financially were failures. All those given opportunity to help themselves were successes, and are now drawing salaries of from $5,000 to $25,000 per annum."

This statement certainly presents a gloomy outlook for the advocates of free tuition and heavily endowed scholarships, and it may be urged, perhaps with justice, that Mr. McMillin has made use of a false unit in evaluating success.

But it was probably true that every one of those educated at his expense had definitely in view the acquisition of knowl-

edge and skill for the purpose of earning money. It is also true that "salary" is a much better measure of success than income from business, investments or inheritance, because it is an evaluation by others, whose interest is to minimize rather than exaggerate.

Mr. McMillin's connection with the Ohio Academy of Science began twenty-five years ago.

At the meeting in December, 1898 "Professor Lazenby reported that Emerson McMillin had given $250.00 to the trustees of the Academy to be expended in such ways as they thought best suited to promote scientific research, and had said that such a sum might be given annually, provided the use made of the money were satisfactory and it proved to be convenient for the donor to spare it." In order to provide for the administration of such a fund Professor Lazenby offered an amendment to the Constitution of the Academy, establishing a Board of Trustees, consisting of three members to be chosen as at present, but as this could not be acted upon before the next annual meeting the Academy voted to accept the gift and a temporary board was chosen to administer the fund for a single year.

This board consisted of F. M. Webster, W. R. Lazenby and E. L. Moseley. The first Board of Trustees elected under the amended constitution consisted of F. M. Webster, H. C. Beardsley and J. H. Schaffner.

In a communication from Mr. McMillin a year or two later he expressed a preference for the use of the fund as a direct subsidy or gift "to entirely competent and experienced investigators, not otherwise provided with financial support," rather than for printing or publication, adding, however, that he did not wish to dictate in any way as to the use of the gift.

For a number of years annual statements of the expenditure of the fund were submitted to him, and in some instances his opinion was asked as to the wisdom of making grants for certain kinds of research. In all cases his response was such as to indicate a desire not to interfere with or influence the policy of the trustees.

It is interesting to note, however, that he did, in one of his letters express himself as rather strongly opposed to allowing his annual gift to accumulate in order to form a permanent fund. Though declaring that the Academy could do as it liked, he added, "On general principles I am opposed to permanent

funds. . . The future will be able to take care of itself. It is much easier now than it was a generation ago to secure funds for this work, and it will be much easier a generation hence than it is now." During the bond-buying period of the late war I wrote him of the investment of $500.00 of the fund in a Liberty bond which met with his cordial approval.

In nearly every one of his letters to the Trustees or the Secretary of the Academy, he speaks of his strong desire to attend its meetings, but as far as I know, he was never present at one of them. There were, however, frequent expressions of great interest in it and its work. At my request a few years ago, our associate, Dr. Herbert Osborn, prepared a list of published contributions to science which had been made possible in a large measure through his annual gift. This was sent to him and upon it he remarked:

"The research fund seems to have been pretty lively and doing work out of proportion to its size. The workers rather than the cash, probably are entitled to the credit."

At another time he wrote:

"The Academy needs to live centuries. I cannot, at most, live but a few years, much as I would like to be permanently established at Darlington."

The last meeting of the Academy happened to occur on the days just preceding the seventy-eighth anniversary of Mr. McMillin's birth and the Committee on Resolutions reported a congratulatory message which was telegraphed to him by our Secretary, as follows:

"The Ohio Academy of Science in its thirty-second annual meeting in Columbus desires to extend to you on the occasion of your seventy-eighth birthday its heartiest congratulations, and wishes to express to you its appreciation of your continued support of scientific research through the Academy."

In reply to this we have his last message to us, as his death occurred a few weeks later. It is addressed to Edward L. Rice, Secretary, and reads as follows:

Darlington, Mahwah, N. J., April 18, 1922.

"Dear Mr. Secretary:

"Your telegram conveying the birthday greetings of the Ohio Academy of Science was received on time, and was the best tonic I have received during the last fifteen months of almost constant illness.

"I do thank you and the Academy most sincerely,

"Emerson McMillin."

# OBSERVATIONS ON THE SEXUAL STATE OF VARIOUS PLANTS.*

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In recent years the writer has accumulated a considerable number of records of experiments and observations on various phases of the sexual state of plants which, although hardly extensive enough for special treatment, are nevertheless of importance in leading to a correct understanding of the nature of sexuality in the sporophytes of the higher plants. A number of the more important observations are, therefore, presented below which may give additional support to some important conclusions previously reached and published from time to time.

## Acnida tamariscina (Nutt.) Wood.

Experiments have been conducted on this diecious plant in the hope that a method for producing sex reversal might be discovered which would prove as effective as the methods used with the hemp, hop, and Arisæma. So far the effort has been only partially successful, only a few intermediates having been produced. The species is a very abundant weed in the cultivated fields of North Central Kansas where extensive observations were made in the field to determine its normal sexual expression. It seems to be normally strictly diecious. The typical staminate flower has five sepals and five stamens, while the carpellate flower has an ovulary with three prominent stigmas. The carpellate flower is described as wanting a calyx but the two minute bracts situated immediately beneath the ovulary may just as well be regarded as a reduced calyx (Fig. 1a). In either case the vegetative parts of the flower are strongly dimorphic. There are no vestiges of stamens in the carpellate flower but the staminate flower has a small vestigial gynecium without stigmas (Fig. 1b).

One carpellate intermediate plant had a large number of normal carpellate flowers in a simple spike-like inflorescence but in the middle of the inflorescence a single bisporangiate

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flower developed which had an ovulary with two sigmas and beside this a perfect stamen bearing pollen. (Fig. 1c). There was thus sex reversal in only one little group of cells in this entire plant which managed to develop a perfect stamen. All the remaining part of the inflorescence remained in the female state.

One staminate intermediate plant produced a flower in the leaf axil of the second leaf that had an ovulary-stamen complex with fairly well-developed stigmas (Fig. 1d). The remaining flowers were pure staminate.

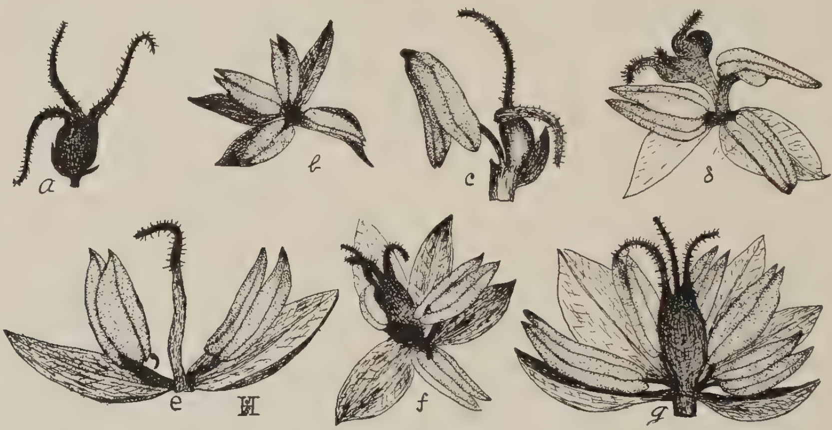


FIGURE 1

Fig. 1. Flowers of Acnida tamariscina (Nutt.) Wood. a—Typical carpellate flower from carpellate plant, showing the three stigmas, the ovulary, and the two perianth bracts or sepals below. b—A young staminate flower from a staminate plant showing the sepals, stamens, and vestigial ovulary in the center. This flower is abnormal in having only 4 stamens and 4 sepals instead of 5. c—Bisporangiate flower from a carpellate plant. This flower was in the middle of a rather long carpellate inflorescence. The perfect stamen was the only staminate structure developed on the entire plant, all the other flowers having pure female expression. d—Abnormal, intermediate flower from a staminate plant with slight expression of femaleness. Three sepals have been cut away. None of the 3 stamens are normal in appearance. The one in the stamen-carpel complex has two long microsporangia and one short one. The ovulary is only slightly developed but has three short stigmas and on one side a small neutral microsporangium. e, f, g—Flowers from an intermediate plant which had all the flowers more or less bisporangiate. The plant was probably a modified staminate plant. The flower represented by e had a rudimentary ovulary ending in a single stigma, 5 normal stamens and 5 normal sepals. f—Flower with 4 sepals, 2 normal stamens, and a fairly well developed gynecium with 3 stigmas. On the upper part of the ovulary wall, at one side, is a sessile anther with 2 microsporangia. g—Bisporangiate flower with 5 normal sepals, 5 normal stamens, and a nearly perfect gynecium with 3 stigmas.

Another staminate intermediate plant had numerous bisporangiate flowers and a number of pure staminate flowers (Figs. 1e, f, g). This intermediate plant had part of its flowers as follows:

1. A flower with 6 stamens and 6 sepals.
2. A flower with 5 stamens, an ovulary with 3 stigmas, and 5 sepals.
3. A flower with a distorted ovulary with 3 stigmas and a small anther of 2 microsporangia on its side at the top, and with 2 stamens and 4 sepals.
4. A flower with 4 stamens, an ovulary with 3 stigmas, and 5 sepals.
5. A staminate flower with 4 sepals and 4 stamens.
6. A staminate flower with 5 sepals and 5 stamens.
7. A flower with 5 sepals, 5 stamens, and a prominent vestigial ovulary with one stigma.
8. A flower with an ovulary with 3 stigmas, 5 stamens, and 5 sepals.
9. A flower with an ovulary with 5 stigmas, 2 stamens, and 5 sepals.
10. A flower with an ovulary with 3 stigmas, 3 stamens and 4 sepals.
11. A flower with an ovulary with 4 stigmas, 4 stamens and 4 sepals.
12. A flower with an ovulary with 4 stigmas, 3 stamens and 5 sepals.

The disturbance in the sexual state, caused a great confusion in the morphological expression of the flower not unlike that which occurs in the winter hemp plants, although as will be noted from the above catalog there seems to be a tendency to produce the parts in fives.

It will be seen, therefore, that although the writer has not yet discovered the proper environment for inducing considerable sex reversal in Acnida tamariscina, the short daylight period of December has apparently caused a minute percentage of reversal and this reversal is in both directions, the staminate condition to the carpellate and the carpellate to the staminate. The sexual dimorphism present was, therefore, not due to special homozygous or heterozygous sex factors, for if such had been the case reversal could at the most have taken place only in one direction. Furthermore, it is not at all a case of abnormal

chromosome complex because in that event all the flowers on a plant should have been effected somewhat similarly. The conclusion is plain that the dieciousness of Acnida is like that of the hemp caused by a reversible sexual state, any given state established at the beginning of the ontogeny being quite fixed within a certain range of environmental factors.

In Figure 1 are presented drawings of normal and intermediate flowers which will show some of the diversity of morphological expression when the sexual state has been altered in the vegetative tissues of the individual.

## Thalictrum dasycarpum Fisch & Lall.

In the field Thalictrum dasycarpum consists in any given season of pure carpellate plants, pure staminate plants, and a large percentage of intermediates, grading from plants which have about an equal number of staminate and capellate elements to the two extremes where a carpellate plant may have a solitary stamen and a staminate plant a single carpel, among a profusion of normal flowers. The writer asked himself the question whether the different categories of plants, pure carpellates, pure staminates, and the individuals of the various degrees of male and female expression, are fixed in their sexual nature and whether this sexual nature is due to an hereditary complex in the cells of the individual that controls the sexual expression.

A pure staminate plant and a pure carpellate plant were transferred in 1920 from a rich moist habitat to a rather dry clayey soil on the north side of the greenhouse and given no further attention except an occasional watering. In 1921, the staminate plant had some carpels. The carpellate plant was accidentally broken off at the top and did not bloom. In 1922, the staminate plant had numerous carpels and also some entirely carpellate flowers, and the carpellate plant had numerous stamens and also some flowers entirely staminate. The originally carpellate plant was decidedly more staminate the second year than carpellate.

From this simple experiment it is, therefore, plain that our notion of the fixity of the sexual state is quite wrong and that the nature of the plant may change from year to year. The cause of the different grades of sexual expression is not to be found in a study of specific hereditary constitutions. What

makes a plant pure carpellate, pure staminate, or intermediate in sexual expression in any given year or period of years is not due to any heredity compelling maleness, femaleness, or intermediateness, but is due to the fact that the heredity is of such a nature in the species as to permit the sexual expression to vary with the environment. As one finds the various types of individuals in the field, one knows that the different types must all have the same hereditary constitution which is of such a nature as to allow the sexual state to be easily changed, and the probability of an individual remaining of the same type for any length of time in a changing environment is remote. Thalictrum dasycarpum is, therefore, in strong contrast in respect to its sexual nature with a diecious species like Acnida tamariscina in which a given sexual state once established is apparently not easily changed.

## Acer saccharinum L.

The silver maple is a diecious species which shows intermediate individuals of varying degrees of staminateness and carpellateness and frequent reversals of the sexual state in its branches in both staminate and carpellate individuals. Often there are typical staminate flowers showing normal stamens and reduced gynecia on prevailingly carpellate plants side by side with typical carpellate flowers. Mingled with these there may be various types of intermediate flowers as follows: carpellate flower with one fruitful stamen with the other stamens reduced; carpellate flower with two fruitful stamens and the remaining ones reduced; carpellate flower with three fruitful stamens and the remaining ones reduced; flower with a normal gynecium and all the stamens enlarged and fruitful, or a completely bisporangiate flower.

Sometimes a branch on a staminate tree changes from completely staminate below to completely carpellate above with various types of more or less perfectly bisporangiate flowers on the transition zone. Branches have been found on a carpellate tree that were first carpellate, i. e., had short side branches or clusters with normal carpellate flowers, and then continued with a zone, a foot or so long, with all the flowers typically staminate, and finally by another reversal became carpellate again toward the outer end. In such cases there must be either a double reversal of the sexual state itself or of some more

primary condition leading up to the perfected sexual state. Femaleness is expressed for a time in the branch and further on maleness and still farther up the branch femaleness again becomes established.

Some trees are apparently entirely staminate or entirely carpellate at least for the season. Occasionally a tree has only a trace of the flowers of the opposite sexual state, while some appear to be about equally staminate and carpellate. Such trees may be considered to have a neutral meristem in the same condition in regard to sex as that in ordinary monecious species or species with bisporangiate flowers, while those trees that are decidedly or completely staminate or carpellate in expression may be supposed to have a physiological state already established in the meristem which under ordinary conditions invariably leads to a certain sexual expression or which under a changed environment reverses to an opposite condition leading on to the opposite sexual state.

A remarkable condition is presented by plants of the maple type of sexuality in that when the sex is reversed the conditions of development become the same as those present in trees of the opposite sexual state. A flower which has been completely reversed from the staminate condition not only has the ovulary normally developed but its stamens are reduced to vestiges although it is borne on a staminate tree, and in the same way a staminate flower on a carpellate tree has a vestigial ovulary. This peculiar phenomenon is probably not due in these cases to the diffusion of hormones from cell to cell but rather to reversals in cells or groups of cells at a given stage in the ontogeny. The vestigial structures may for a short time be in a preliminary stage leading to a given sexual state and later this state fades out in the incept to a neutral state or is even reversed to the opposite sexual state which inhibits any further development in the given line.

A sex limited character was observed in a staminate tree with some carpellate branches and some partly carpellate branches which showed the complexity of the sexual states and sexual expressions to be analyzed and interpreted. Both the normal staminate flowers and the reversed carpellate flowers had red anthers, the latter of course being vestigial, while the stigmas of the carpellate flowers were long and red and the vestigial stigmas of the staminate flowers were short and green.

## Acer rubrum L.

The red maple is a diecious tree which seems to have less sex reversal than the silver maple. Nevertheless, it is not difficult to find staminate trees with well-developed carpellate flowers and carpellate trees with perfectly developed staminate flowers, each with its appropriate vestigial structures. The writer has found a number of such trees. The diverse nature of the sexual expression shows, as in the silver maple, that the sexual characters are not at all due to any special sexual hereditary complex of chromosomes or factors but to reversible states set up at various points in the tree which already had a distinctive trend toward a single sexual state. Segregation and aggregation of chromosomes are not involved in the sex determination or reversal.

## Thalictrum dioicum L.

This species of meadow-rue is rather strictly diecious. Search has been made for two seasons for intermediate individuals and five have thus far been found after a search of several hours. It is to be inferred that a small percentage of intermediate plants is produced at each blooming season. The intermediate plants were as follows: 1. A staminate plant with a single flower which had a peculiar stamen-carpel complex with a well-developed stigma. The remaining flowers were all of the normal staminate type except one which had a marginal structure half stamen and half sepal. 2. A plant exactly intermediate in sexual expression. All the flowers on this plant were bisporangiate, the carpels being mostly in the center and the stamens at the outer margin. 3. A carpellate plant with several flowers having one or more imperfect stamens. 4. A carpellate plant with a number of typical staminate flowers and some bisporangiate flowers. 5. A carpellate plant much like No. 4, but with fewer staminate flowers.

Two carpellate plants which showed some stamens were dug up in the spring of 1922, planted in pots in the greenhouse, and well fertilized with cow manure. One died but the other grew well and bloomed in September, again developing some stamens along with numerous carpellate flowers. In November the plant bloomed again, showing the same confusion of sexuality, but at the third period of blooming in January, 1923, only carpellate flowers were produced. So this individual may also appear as

a pure carpellate from time to time although it has shown its potentiality to be bisporangiate at times.*

These few plants show that the sexual state in Thalictrum dioicum ranges all the way from decidedly intermediate plants with bisporangiate flowers through every conceivable degree to strictly monosporangiate individuals. The condition is essentially the same as in Thalictrum dascycarpum with this important difference, however, that while sex reversal is very easily brought about in the latter species and there are thus always abundant intermediates present, in Thalictrum dioicum the sexual state is strongly fixed in the plant's normal environment and intermediates are quite rare. There is again no question but that sex reversal takes place in both directions, maleness to femaleness and femaleness to maleness. As is well known there are species of Thalictrum with normally bisporangiate flowers, and from this primitive condition a series of species are known grading from the irregular monecious type through dieciousness with numerous intermediates to dieciousness in which the intermediate condition is very rare. Such examples show that the attempt to explain sexual states by a simple Mendelian formula of homozygous and heterozygous hereditary constitutions falls entirely beside the mark.

### Aesculus glabra Willd.

The Ohio buckeye is a monecious species with staminate and carpellate flowers commingled in the same inflorescence. Both flowers have prominent vestiges of the opposite set of sporophylls. There are also flowers that are intermediate between the two extremes, apparently of the normal bisporangiate type. The petals of the staminate flowers are more yellowsih in color than those of the carpellate flowers which have a decidedly greenish tinge and are much less open. These secondary sexual characters sometimes become quite prominent en masse when entire panicles are staminate or nearly entire panicles carpellate.

Individual trees were studied and it is evident that they grade all the way from purely staminate (observed in young plants only) to decidedly carpellate individuals. No pure carpellate plants have been observed but some have been found to have a very much larger percentage of carpellate flowers than

*At the end of this plant bloomed again with all the flowers carpellate.

staminate. Three trees were especially studied because of their apparently extreme staminateness. Some of their panicles were entirely staminate and some had a single carpellate flower; others had two or more carpellate flowers with well-developed gynecia. A young tree, as stated above, probably in its first or second blooming season was found to be purely staminate in sexual expression. Such pure or decidedly staminate trees can sometimes be discovered through the bright appearance of their flower clusters. In this young tree the flower clusters were compact and very showy with bright yellow petals, because of the extreme condition of the male state.

It is possible that the sexual state changes from time to time because of changing environment or the progress of senility, but no definite observations have been made along this line except that some trees appear to be much more fruitful in some years than in others, which might, of course, be due to other causes than the relative amount or degree of maleness or femaleness expressed for the giving seasons. From these observations, the buckeye tree is found to be a monecious species which has individuals ranging, in any given year, in sexual expression, from pure staminate to decidedly carpellate. This range of the sexual condition from pure staminate to decidedly carpellate but not to the complete carpellate condition recalls a somewhat similar state of affairs in Arisæma dracontium (L.) Schott.

## GENERAL DISCUSSION.

Although the careful study of the sexual states of monecious and diecious trees is attended with some difficulty, such studies would assist materially to a correct understanding of the nature of sex and the way in which the sexual state is developed in the individual or a part of the individual. The higher conifers would apparently also be an especially fruitful region for study as well as the interesting order of Sapindales to which buckeyes and maples belong.

The study of monecious and diecious species has shown that moneciousness and dieciousness are but extremes of a common series of sexual phenomena and are of varying degrees of intensity and extent. The intensity of the sexual state is independent of the monecious or diecious condition. In either state a species may be decidedly constant or decidedly unstable. The diecious species may have the given sexual state so slightly developed that even under the ordinary environment reversals take place

quite frequently; the states may be so fixed that reversals occur only in the presence of unusual ecological conditions; or they may be so intensely developed that so far no intermediates are known to have been produced, either in the natural environment or when the plant is growing under extremely different ecological conditions. Similarly, monecious species may be so constituted that there is little variation between individuals in respect to their sexual expression or they may have the given neutral or sexual state so slightly established in the cells of the individual, that determinations or reversals do not follow any very regular course in the ontogenetic development, in consequence of which the type of expression varies decidedly from one individual to the next. The lowest type of monecious species is that in which the one or the other sexual state is established permanently at the base of the floral axis, resulting in monosporangiate flowers. In the more extreme types, the time of determination of the sexual state is shifted back to an earlier axis thus producing entire inflorescences with one type of flower or entire branching systems involving numerous inflorescences or even considerable parts of the vegetative structures. Besides these there is the very common type in which sex reversal takes place at a given level or zone in the inflorescence itself simulating the sexual zonation to be observed in the ordinary bisporangiate flower.

The diecious condition is presumably brought about by the establishment of an hereditary constitution in which sex determination is coincident with fertilization in the ordinary environment in which the species lives. This shifting of the time of determination has nothing to do with the relative intensity or permanence of the sexual state set up; for as the writer has ascertained, both from observation and experiment, sex reversal and changes in the sexual state can be brought about as easily, if not more so, in the diecious sporophyte individual as in the monecious. If the sex is determined or reversed at the time of fertilization, i. e., at the time of the fusion of the male and female nuclei, the cause and the mode of determination must, nevertheless, be fundamentally the same as when the determination or reversal takes place in the vegetative incept of the flower bud or sporophyll. *Before we could assume that a new functional activity, a new chemistry or physics, was at work, we would need some very strong evidence for the assumption. This observation applies to unisexual individuals with allosomes as well as to those without.*

Bisporangiateness, moneciousness, and dieciousness, therefore, fall into a progressive series of many stages in respect to the intensity and fixity of the sexual state, all depending on a fundamentally similar physiological activity, the more prominent stages being as follows:

1. Typical bisporangiate species.
2. Bisporangiate species with the development of some monosporangiate flowers, either staminate or carpellate, or both.
3. Monecious species with some bisporangiate flowers.
4. Monecious species normally without bisporangiate flowers.
5. Monecious species which produce individuals of a greater or less degree of staminateness or carpellateness in the individual, together with occasional individuals purely staminate or purely carpellate or with both these types occasionally present.
6. Diecious species with numerous intermediates of all degrees and with sex reversal easily accomplished.
7. Diecious species with few intermediates and with apparently little sex reversal.
8. (?) Diecious species with no intermediates and no sex reversal at least under normal conditions.

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# SOME CONFUSED SPECIES OF PHLEPSIUS AND EUTETTIX (HOMOPTERA).

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## PHLEPSIUS STROBI Fitch.

*Bythoscopus strobi* Fitch, Fourth Report, N. Y. State Lab. N. H. p. 58, (1851).

This species was described by Fitch, as taken from Pine, but Van Duzee and later authors have applied the name to a species of Eutettix which is strikingly like it in general appearance but which occurs on *Chenopodium*. The Fitch description reads:

"PINE BYTHOSCOPUS, *B. strobi*. Yellowish-brown; elytra with three white bands, and closely inscribed with fuscous points and lines, outer margin with small fuscous spots; beneath brown; legs pallid, with spine-bearing black dots. Length, 0.20. Common on pines in May. No. 771, male; 772, female." (Vide reprint in 46th Rept. State Museum, N. Y., 1893).

While very brief this applies perfectly to a small species of *Phlepsius* that I have taken from Pine in Ohio and to specimens received from collectors in New York and, what is most important, the specimens from pine agree perfectly with the specimen from the Fitch collection in the National Museum. A more detailed description follows:

Resembling *Eutettix chenopodii* but with longer, angular edged vertex and with three whitish bands on elytra, the anterior one extending from scutellum to half way point on clavus. Length, female, 4.5–5 mm.; male, 4.1 mm.

Head wider than pronotum, vertex angular, one-half longer at middle than next the eye, margin angular; front longer than wide; clypeus with sides nearly parallel, apex truncate; loræ nearly touching margin of cheek. Pronotum twice as long as vertex, hind border slightly emarginate.

Color gray fulvus. Vertex fulvus mottled with whitish and with pronotum and scutellum brown, irrorate with gray or whitish; elytra with bands of white and brown, a white band across base from middle of scutellum to middle of clavus, another just beyond apex of clavus and a third just before the apex, are inscribed with delicate brown lines.

Genitalia. Female last ventral segment long with median third produced. Male valve short, rounded behind, plates triangular, tips acute.

Specimens have been taken at Cantwell Cliff, Ohio, on Pine, in Guernsey Co., Ohio, by Mr. F. E. Guyton, and I have examined specimens from Yaphank, L. I., N. Y., collected May 30, 1911, by Mr. Chris E. Olsen.

### PHLEPSIUS UHLERI, Van Duzee.

Similar to *P. strobi* Fitch in size and coloration but with the vertex less angular, horizontal and distinctly transversely depressed while the pattern on the elytra differs in that the middle white band is angular and more broken, and the white spots clearer and more sharply defined.

The specimen in the National Museum, presumably one from which the description was written is labeled "Odenton Aug. 1" and "Phlepsius uhleri V. Duz. Md."

The Van Duzee description is good and the above comparison will suffice to separate the species from *strobi* Fitch (not Van Duzee) to which it seems most closely related. From *lippulus* it differs in the shorter vertex as well as somewhat smaller size and especially in the male genitalia. While in the same group as *franconiana*, *slossoni*, *fastuosus* and *punctiscriptus* it is much smaller than any of these and has decidedly different genitalia.

### EUTETTIX CHENOPODII n. sp.

*Phlepsius strobi* Van Duzee Trans. Am. Ent. Soc. XIX, p. 67, 1892.
*Eutettix strobi* Ball. Pr. Dav. Acad. Sci. XIII, p. 44, 1907.
*Eutettix strobi* Van Duzee Catalogue, p. 665. 1916.

Similar to *Phlepsius strobi* Fitch, but with the vertex short, rounded to front and the elytral picture consisting of two whitish bands instead of three. Length, female, 5.5; male, 4.5.

Head slightly wider than pronotum; vertex short rounded in front with a shallow transverse depression, scarcely longer at middle than next the eye, obtusely angulate to front; front slightly longer than broad, clypeus short, scarcely widened at tip; loræ elongate, the tip reaching border of cheek. Pronotum more than twice as long as vertex, hind border concave.

Color, light fulvus irrorate with light yellow or whitish. Elytra brown, with two white bands, the forward one oblique and extending from tip of scutellum to costa at middle, the hinder one crossing the ante-apical cells.

Genitalia: Female last ventral segment twice as long as preceding, hind border rounded with a notched lobe at the middle. Male valve rounded behind, plates triangular, tips acute.

This is a common species throughout the eastern U. S. and its nymph is found on Lambs quarter (*Chenopodium*) where it produces purple spots that agree in color with the nymph. The description is from specimens collected in Iowa and Ohio, but records under the name of *strobi* carry its distribution from Maine to Utah and south to North Carolina and Texas.

The nomenclature of this species presents a peculiar puzzle as it was actually described by Van Duzee under the name *strobi* which as shown above, must apply to a different species and the name would be preoccupied in *Phlepsius*. Ball, however, described the species having placed it in *Eutettix* in which genus the name *strobi* has not been used for any other species. However this was simply a transfer of the Van Duzee misnomer and as the species occurs on *Chenopodium* and not on *Strobus* it will avoid confusion to give it a new name and preferably one which indicates its restricted food habit.

Type and paratype specimens of above description in author's collection.

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